# Evolutionary models of the Earth with a grain size-dependent rheology: diffusion vs dislocation creep

A.B. ROZEL[1], G.J. GOLABEK[2], M. THIELMANN[2] AND P.J. TACKLEY[1]

[1] ETH Zurich, Switzerland
[2] BGI Bayreuth, Germany

We present a set of 2D numerical simulations of mantle convection considering grain size evolution and a composite visco-plastic rheology including diffusion and dislocation creep. A 1D parameterization allows us to anticipate the stress and grain size conditions for the present-day temperature profile in a convection cell, considering that phase transitions reset the grain size to a small value. This way we are able to obtain self-consistent 2D convection models together with non-equilibrium grain size for present-day conditions. This controls the partitioning between diffusion and dislocation creep. However, the internal temperature of the mantle is thought to have significantly evolved throughout the Earth's history. Using a higher internal temperature usually decreases both viscosity and internal stresses. In our case, a high temperature potentially increases the grain size, which tends to increase the viscosity: the temperature and grain size-dependence of the viscosity are in competition. We study the evolution of the diffusion-dislocation partitioning throughout the history of the Earth. We report the evolution of grain size and stress over time in our simulations. Several complex processes are included in our models like grain size evolution being a sum of grain growth and dynamic recrystallization. Additionally, all our simulations consider thermochemical convection in a compressible mantle with melting producting basaltic crust and depleted mantle.